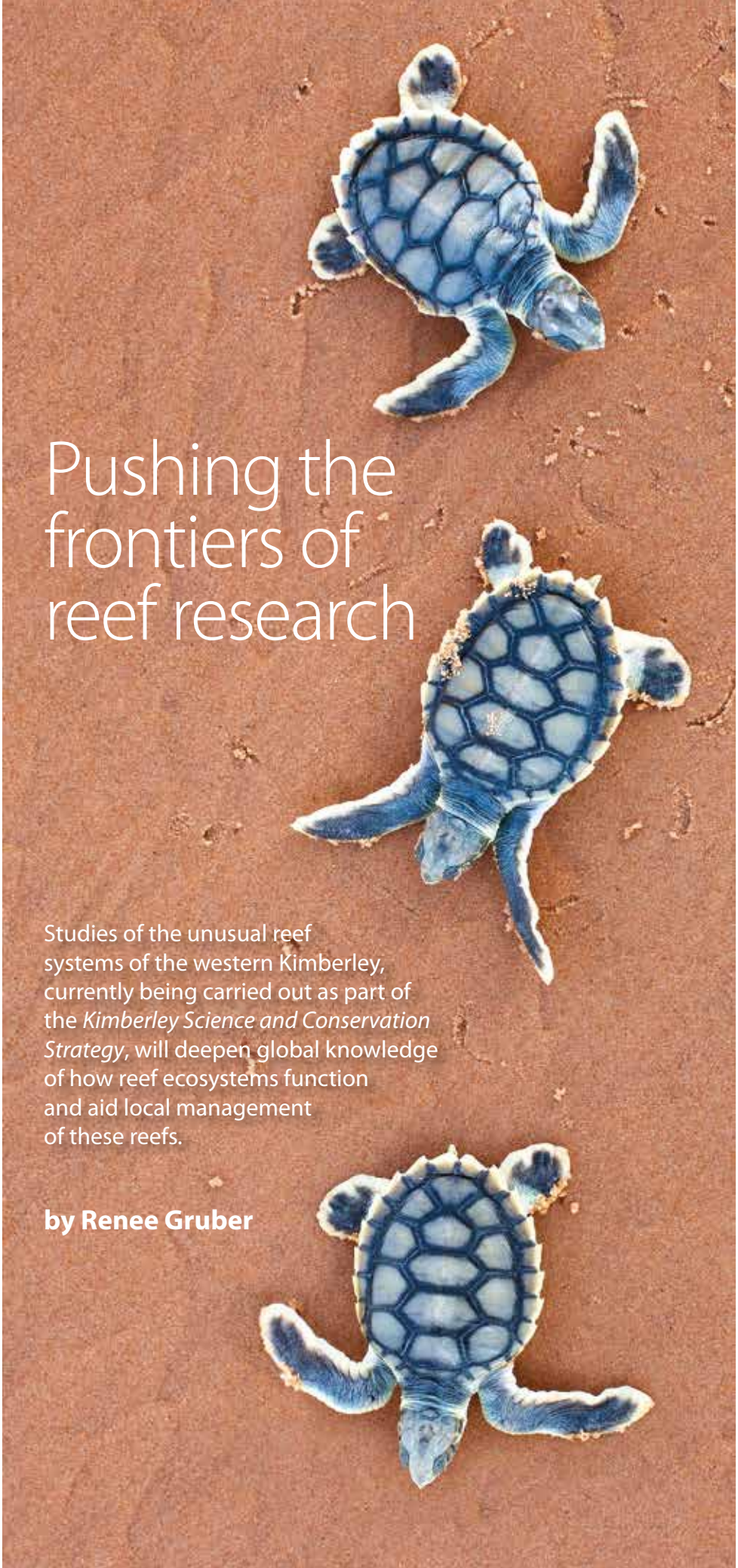


Pushing the frontiers of reef research

Studies of the unusual reef systems of the western Kimberley, currently being carried out as part of the *Kimberley Science and Conservation Strategy*, will deepen global knowledge of how reef ecosystems function and aid local management of these reefs.

by Renee Gruber

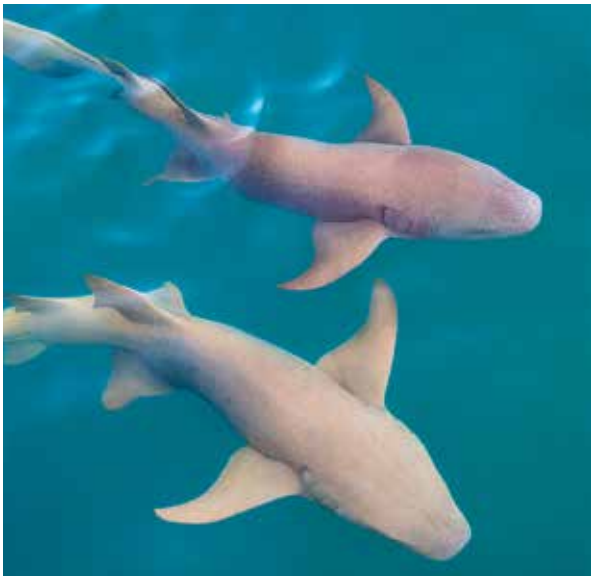
The reefs of the west Kimberley fringe rocky islands, forming platforms above plunging inter-island channels. They are built by a mixture of coral and coralline algae, and some support seagrass communities in sandy back-reef lagoons. They spend part of the time exposed due to the Kimberley's famous tides (which have a range of up to 10m in the west Kimberley).

Late in 2012, researchers from The University of Western Australia began a four-year field study of the west Kimberley reefs. Current understanding of reefs has arisen from studies in wave-dominated environments, and many reefs around the world are in highly degraded condition, which is why understanding pristine, tidally-dominated reefs is so important to both scientists and managers.

FLOW OF LIFE

The research focuses on the water flow over these unusual reefs and the consequences for reef community productivity. The life of aquatic organisms that grow attached to the seafloor is closely linked to water flow; it determines where they establish, how efficiently they feed, and their productivity. For instance, the speed at which water flows around coralline algae regulates the ability of the algae to utilise dissolved nutrients (such as nitrogen and phosphorus) essential to growth: faster flows cause nutrients to reach these organisms rapidly, while stagnant water results in slower uptake. The same principle holds for corals, sponges, and other filter feeders that extract tiny particles of organic material from the water. The photosynthesis of primary producers such as algae and seagrass is called 'productivity' and is measured by increases in oxygen levels in the water column. Seagrass productivity supports animals such as dugong (*Dugong dugon*) and turtles, which are common around these reefs, and productivity in algae builds reef structure.

Left Flatback turtle hatchlings (*Natator depressus*).
Photo – David Bettini



Above left Bardi Jawi ranger Azton Howard taking a water sample.

Above centre The draining reef crest forms a waterfall at low tide.
Photos – Renee Gruber

Above The tawny nurse shark (*Nebrius ferrugineus*) is an 'inshore species' known to occur in the Kimberley reefs.

Below Brown boobies (*Sula leucogaster*) breed along the Kimberley coast and on nearby islands.
Photos – David Bettini

The study site, Tallon Island, lies in the Sunday Island group adjacent to Cape Leveque. This small reef in the centre of the cluster of islands was chosen for its uniform shape, which makes the measurements of water flow easier to interpret. Instruments were secured on the reef with large weights to continuously measure water levels, current velocity, temperature and the concentrations of dissolved oxygen. When the tide dropped below reef level, the researchers collected water samples (on foot) from seagrass- and coralline algal-dominated areas of the reef to compare their oxygen production and nutrient uptake rates.

Another important technique in reef research is the use of 'drifters' to monitor changes in chemistry by tracking parcels of water that move across the reef. As Tallon Island gets very shallow during low tide, mandarins (yes, the fruit) made ideal drifters. These studies are interesting on their own, but we are also pairing results with reef-scale numerical modelling to help integrate findings over daily and seasonal time periods.

Seasonal cycles of light, temperature, and nutrient inputs from surrounding waters modulate the productivity of reef organisms. For example, seasonal increases in light drive increased productivity. We have therefore conducted these experiments during the dry and wet seasons, despite the challenges associated with wet-season work, and our findings will be among the first in the coastal Kimberley.

INTRIGUING QUESTIONS

The Sunday Island group sits on the border between King Sound, a 100km long open gulf, and the coastal ocean. During the wet, several large river systems (the Fitzroy and Lennard rivers) discharge thousands of gigalitres of fresh water into King Sound. Do these seasonal inputs of nutrients 'feed' reefs or is the coastal ocean a more important source? Seasonal sampling of water surrounding the reefs paired with numerical modelling of the west Kimberley is helping to answer this question.

The study is being done in consultation with the surrounding communities, and local knowledge from Bardi Jawi rangers and the Kimberley Marine Research Station has been indispensable. Knowledge gained from the research will be available to the Bardi Jawi rangers and Ardyaloon community to help implement the management plan for the recently established Bardi Jawi Indigenous Protected Area, which includes the Sunday Island group. Ongoing conversations between the rangers and researchers have identified areas where the research can complement traditional knowledge in designing reef monitoring programs. Rangers have been important participants in all fieldwork sampling. It is hoped that this evolving partnership will strengthen community management of healthy reefs.

Early results from the research are demonstrating that the fringing platform reefs of the west Kimberley are globally unique. During the first experiment, reef temperatures were shown to fluctuate up to 10°C in just six hours; which is a greater change than many reefs experience over an entire year! In which other ways are the Kimberley reefs different to the conventional model? Over the next three years, many more surprises and challenges no doubt await.

Renee Gruber is completing a PhD at The University of Western Australia in the role of nutrients in reef productivity. She can be contacted by email (renee.gruber @research.uwa.edu.au).